NEW RECORDS OF CERAMIALES (RHODOPHYTA) FOR THE NORTH-WESTERN MEDITERRANEAN

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ABSTRACT — The occurrence of some uncommon species of Ceramiales (Rhodophyta) in some areas of North-Western Italy is here reported on the basis of collections made over the last few years. *Antithamnion algeriense* is a new record for Italy. For *Antithamnion piliferum* and *Laurencia minuta* subsp. *scammaccae*, species known for Spain and Southern Italy, the present records extend their geographical distribution northward. For *Laurencia glandulifera* female gametophytes bearing cystocarps were observed for the first time. Data on the geographical distribution of these species are also reported and discussed.

RÉSUMÉ — Les auteurs signalent la présence de quelques espèces rares de Ceramiales (Rhodophyta) récoltées sur les côtes de l'Italie Nord-Occidentale. *Antithamnion algeriense* représente une espèce nouvelle pour l'Italie. La signalisation d'*Antithamnion piliferum* et de *Laurencia minuta* subsp. *scammaccae*, connues en Espagne et en Italie du Sud, étend la distribution géographique de ces espèces. Des gamétophytes femelles de *Laurencia glandulifera* avec cystocarpes ont été observés pour la première fois. La distribution géographique de ces espèces dans la Méditerranée est précisée et discutée.

KEY WORDS: New records, Ceramiales, North-Western Mediterranean, *Antithamnion algeriense*, *Antithamnion piliferum*, *Laurencia glandulifera*, *Laurencia minuta* subsp. *scammaccae*.

INTRODUCTION

Early contributions to the marine flora of Tuscany and nearby regions date back to the 19th and to the beginning of the 20th century (Corinaldi, 1839a, 1839b, 1843; Moris & De Notaris, 1839; Meneghini, 1841; Agardh, 1842; Kützing, 1849; Pichi, 1888; Tanfani, 1890; De Toni, 1895, 1917; Preda, 1896, 1897, 1909; Piccone & De Toni, 1900). Recently new studies have provided more detailed knowledge of the algal vegetation of some areas (Cinelli, 1969, 1971; Pignatti & Rizzi-Longo, 1972; Papi *et al.*, 1992; Benedetti-Cecchi & Cinelli, 1993; Pardi *et al.*, 1993; Airoldi *et al.*, 1995) and have led to the collection of species previously unrecorded in this part of the Mediterranean (Cinelli & Sartoni, 1969; Sartoni & Sarti, 1976; Sartoni & Salghetti-Drioli, 1987; Sartoni & Boddi, 1992, 1993; Piazzi *et al.*, 1994).

In the last few years, during surveys of algal communities and *Posidonia oceanica* meadows of the Tuscany coast and its islands, several collections of benthic algae were made; this paper reports observations on some species of Ceramiales (Rhodophyta) hitherto unknown in the North-Western Mediterranean.

MATERIALS AND METHODS

Specimens were collected from the littoral zone to 24 m depth by snorkelling and SCUBA diving; dates and localities of collection are specified for every species in the Observations. Material was stored in 4% formalin in seawater and sorted in the laboratory; permanent slides were prepared for microscope observation.

OBSERVATIONS

Antithamnion algeriense Verlaque *et* Seridi

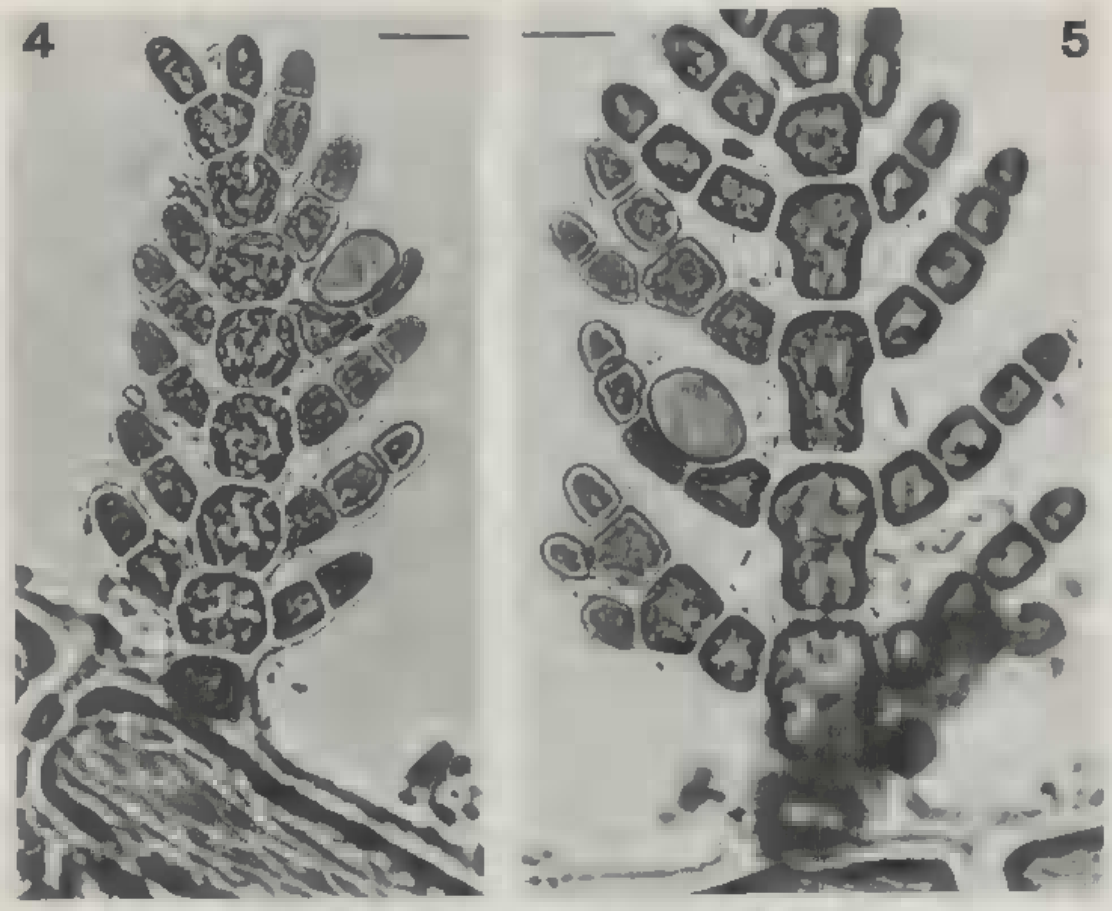
Some sterile filaments of *A. algeriense* were found in June 1995 in an algal turf collected at the base of an outer breakwater at 5 m depth in La Spezia harbour; *Heterosiphonia crispella* (C. Agardh) M.J. Wynne, *Herposiphonia secunda* (C. Agardh) Ambronn f. *tenella* (C. Agardh) M.J. Wynne and *Polysiphonia scopulorum* Harvey were growing mixed with this species. Specimens consist of little-ramified prostrate axes, erect at their tips (Fig. 1). Axial cells are up to 140 µm long and up to 40 µm broad, 3-4 times as long as broad in the mature parts of the filaments. Axes bear distichous opposite whorl-branches throughout the thallus. Whorl-branches are composed of 9-10 cells and are up to 200 µm long. Their basal cell is isodiametric, subquadrate, about 15 µm in diameter; other cells are elongated, up to 2 times as long as broad, and usually bear a pair of opposite first-order branchlets at their distal extremity. First-order branchlets show abaxial ramification but, in the most developed parts of the plants, opposite second-order branchlets are also present (Fig. 2). Apical cells are more or less blunt and 1-2 times as long as broad. New indeterminate axes replace whorl-branches, causing suppression of the opposite whorl-branch (Fig. 3); adventitious axes, arising from the basal cell of some whorl-branches, were also observed. Gland cells are common, ovoid, up to 13 µm long and 10 µm broad; they are borne adaxially on first-order branchlets and contact 2 or 3 cells of the branchlet (Figs 4-5).

The known geographical distribution of *A. algeriense* is limited to the Western Mediterranean; this species has been previously recorded for Bjord-El-Kiffan, Algeria (type locality; Verlaque & Seridi, 1991), Alboran Island (Ribera Siguan & Soto Moreno, 1992) and some localities in Morocco (Gonzàlez Garcìa & Conde Poyales, 1994). The present record is the first for the Italian coast, and notably extends the geographical distribution of this species.

A. algeriense is a well defined species, being characterized by its vegetative features (Verlaque & Seridi, 1991; Ribera Siguan & Soto Moreno, 1992) and it belongs to the group of species of *Antithamnion* which show distichous whorl-branches bearing

Fig. 1. *Antithamnion algeriense* Verlaque *et* Seridi (La Spezia, June 1995, -5 m). Habit. Scale: bar = 230 µm.

Figs 2-3. *Antithamnion algeriense* Verlaque *et* Seridi (La Spezia, June 1995, -5 m). Fig. 2. Whorl-branches bearing opposite second-order branchlets. Scale: bar = 50 µm. Fig. 3. Detail of a young axis. Scale: bar = 50 µm.



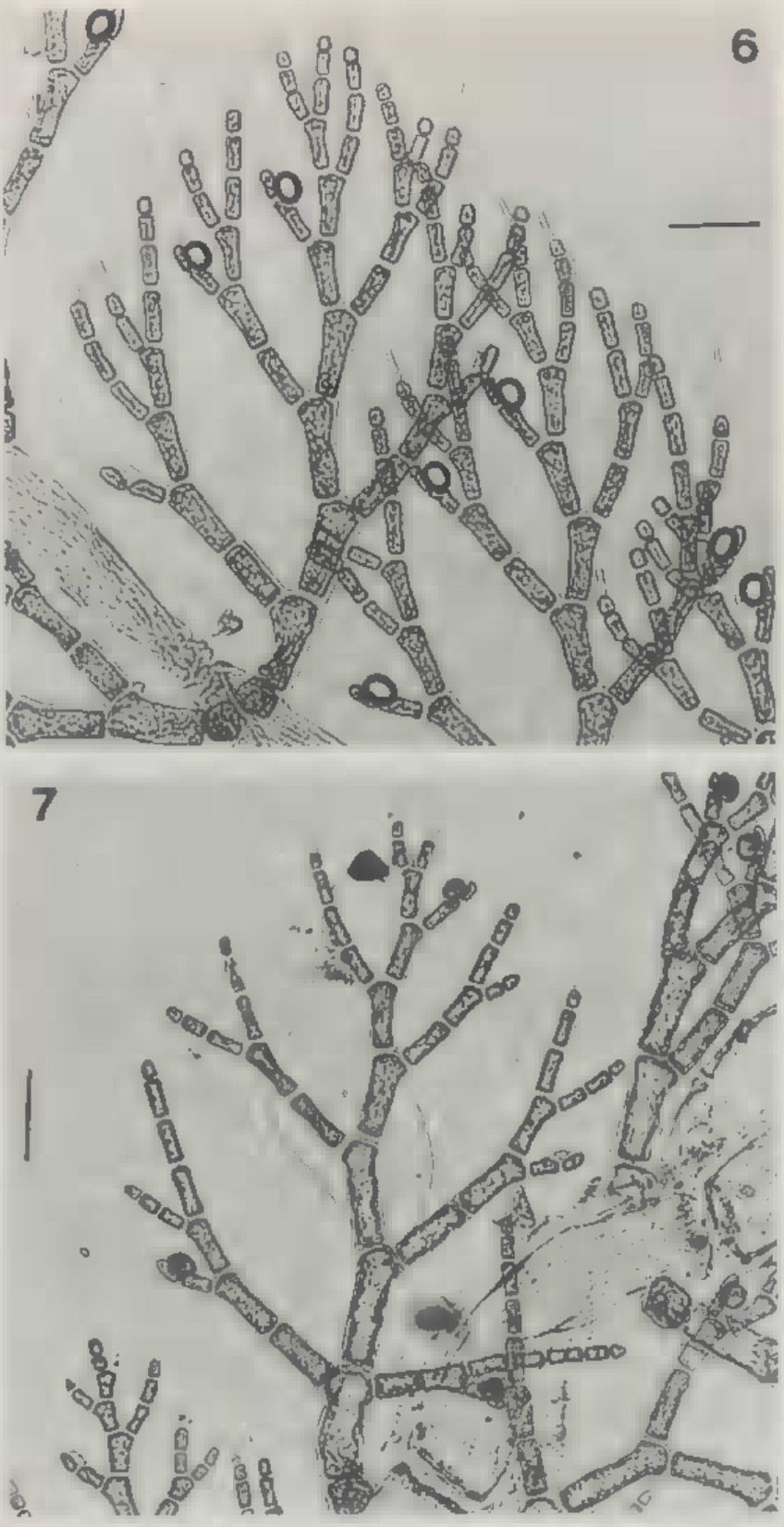
Figs 4-5. *Antithamnion algeriense* Verlaque *et* Seridi (La Spezia, June 1995, -5 m). Fig. 4. A gland cell in contact with two cells. Scale: bar = 10 µm. Fig. 5. A gland cell in contact with three cells. Scale: bar = 10 µm.

opposite and distichous first-order branchlets. Another species showing this feature, *Antithamnion pectinatum* (Montagne) Brauner *ex* Athanasiadis *et* Tittley, has been recorded in the Mediterranean (Verlaque & Riouall, 1989, as *Antithamnion nipponicum* Yamada *et* Inagaki; Curiel *et al.*, 1996); this differs from *A. algeriense* in its bigger overall size, the exclusively abaxial ramification of the second-order branchlets, the acute shape of the apical cells and the number of cells with which gland cells are in contact (always 2 in *A. pectinatum*) (Verlaque & Seridi, 1991).

Antithamnion piliferum Cormaci *et* Furnari

From 1991 to 1995 this species was repeatedly collected at depths ranging from 4 m to 17 m, in the rocky sublittoral south of Livorno; in this area thalli of *A. piliferum*, epiphytic on encrusting corallines and *Peyssonnelia* spp., can be observed throughout the year. Some specimens were also recorded in June 1994 on rhizomes of the seagrass *Posidonia oceanica* (Linnaeus) Delile, collected at 10 m, 17 m and 21 m depths in several sites on Elba Island. Thalli of *A. piliferum* are up to 15 mm long and consist of prostrate axes, attached to the substratum by multicellular rhizoids, with unattached erect tips. In fully developed parts of the plant axial cells are up to 250 µm long and 70 µm broad, and up to 7-8 times longer than broad. Every axial cell bears two opposite erect whorl-branches, alternately branched; whorl-branches of adjacent axial cells are decussately arranged. Whorl-branches are 200-450 µm long; they are formed of 10-11 cells and bear one — to many-celled first order branchlets (up to 300 µm long) (Fig. 6). Occasionally a pair of opposite first-order branchlets is borne by the second cell of the whorl-branches (Fig. 7). First-order branchlets bear abaxial, usually 2 or 3-celled, second-order branchlets, which can be provided with ovoid gland cells. Gland cells are borne on the adaxial side and rest on two cells (Fig. 8). One or two hyaline hairs, up to 200 µm long, are present on many terminal cells; if only one hair occurs, it is slightly eccentric and the apical cell shows a trace of the other hair, previously fallen. The abundance of hyaline hairs seems to exhibit a seasonal variation; in thalli of *A. piliferum* from Livorno these structures appear more abundant in autumn and winter. Reproductive structures have never been observed in Tuscan specimens of this species. Vegetative features of *A. piliferum* were first illustrated by Cormaci & Furnari (1987), who described this species from material collected at Capo Passero (South-eastern Sicily, Italy). Later this species was collected again in several areas of Southern Italy (Cormaci & Furnari, 1988; Cormaci *et al.*, 1992; Giaccone *et al.*, 1992; Alongi *et al.*, 1993; Scammacca *et al.*, 1993; Abdelahad & Cantasano, 1995; Cecere *et al.*, 1996), at Alicante, Spain (Boisset Lopez, 1991) and the Balearic Islands (Sala *et al.*, 1993).

Following the current interpretation of *Antithamnion*, 7 species belonging to this genus are known for the Mediterranean Sea (Cormaci & Furnari 1989; Velaque & Seridi, 1991; Curiel *et al.*, 1996). Among them *A. piliferum* and *A. ogdeniae* Abbott are the only two species which show development of alternate-distichous first-order branchlets; records of *A. antillanum* Børgesen (Boudouresque & Verlaque, 1976; Barcelò, 1987) must be referred to *A. ogdeniae* (Verlaque, 1990). Morphological features that distinguish *A. piliferum* from *A. ogdeniae* were discussed by Cormaci & Furnari (1987) and Verlaque (1990); of these the presence of opposite first-order branchlets in the lower parts of the whorl-branches has generally been considered a distinctive character of *A. ogdeniae*. In fact this feature, occasionally reported by other authors (Boisset Lopez, 1991), has been repeatedly observed also in Tuscan specimens



Figs 6-7. *Antithamnion piliferum* Cormaci *et* Furnari (Calafuria, 2 January 1996, -15 m). Fig. 6. Detail of some whorl-branches. Scale: bar = 50 µm. Fig. 7. Whorl-branches bearing a pair of opposite first-order branchlets. Scale: bar = 50 µm.

Fig. 8. *Antithamnion piliferum* Cormaci *et* Furnari (Calafuria, 2 January 1996, -15 m). Detail of two gland cells. Scale: bar = 10 µm.

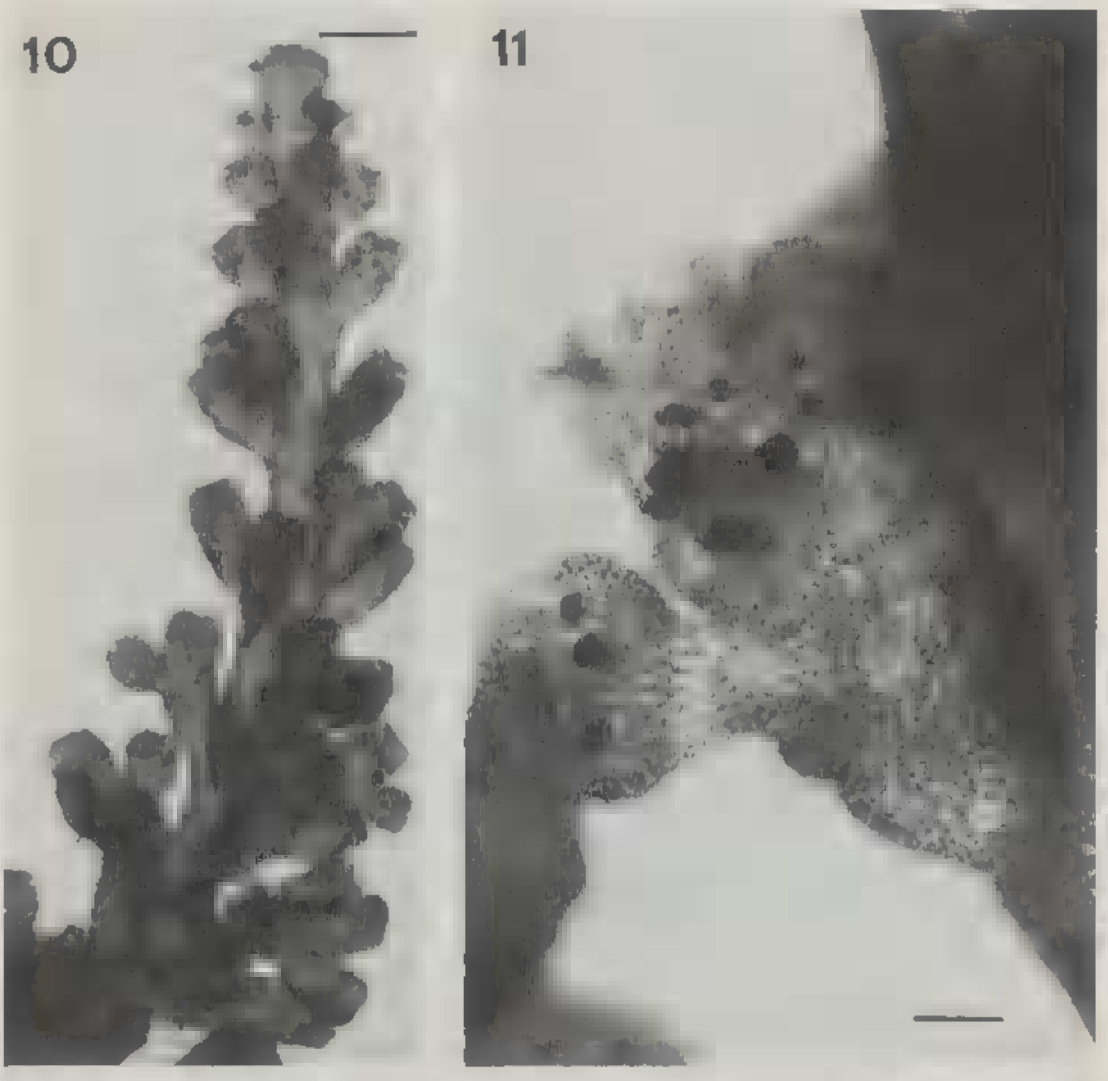
of *A. piliferum*. In numerous plants (particularly those collected on *P. oceanica* rhizomes) a few whorl-branches bear opposite branchlets in the lower parts, but in other specimens opposite branchlets are more abundant and present in many fully developed whorl-branches; all the intermediate forms between these two extremes can be observed. So, in Tuscan specimens of *A. piliferum*, this feature appears to be quite variable and we think that a low taxonomic value should be given to it. The record of *A. ogdeniae* for Livorno in Airoldi *et al.* (1995) should be referred to specimens of *A. piliferum* with predominantly opposite first-order branchlets.

Laurencia glandulifera (Kützing) Kützing

Specimens of *L. glandulifera* were collected on several occasions in the low littoral of the rocky shore at Calafuria (south of Livorno), where they form small

Fig. 9. *Laurencia glandulifera* (Kützing) Kützing (Calafuria, June 1995, low littoral). Habit. Scale bar = 4 mm.

isolated patches, bright orange to deep red in colour; in this locality *L. glandulifera* is more abundant and better developed in spring and summer months. The parasitic red alga *Erythrocystis montagnei* (Derbès *et* Solier) Silva frequently occurs in the apical pits of this species; sometimes *Janczewskia verrucaeformis* Solms-Laubach has been found growing on the erect axes. Tetrasporangial plants of *L. glandulifera* were also observed in May 1996 in the sublittoral fringe on a jetty at Capo Enfola (Elba Island). Plants are 20-60 mm tall. From a primary discoid holdfast several erect and decumbent axes arise. Axes are terete, about 1 mm in diameter, and bear irregularly to subverticillately arranged branches; the branches usually bear many short branchlets, with wart-like ultimate branchlets subverticillately disposed (Fig. 9). Outer epidermal cells are polygonal, 50-100 µm long and 40-70 µm broad, and in transverse section are isodiametric to slightly radially elongated. Secondary pit connections occur between outer cortical cells; these show spherical hyaline bodies (corps en cerise) in living material and are clearly protruding in the apical parts of the thalli. Tetrasporangial branchlets are clavate, up to 700 µm broad in their widest part (just below the apices) (Fig. 10). Tetrasporangia are cut off abaxially from pericentral cells. Mature sporangia, 100-120 µm in diameter, are tetrahedrally divided; their arrangement is parallel to the central axis of the branchlets (Fig. 11). Cystocarps are usually abundant on female



Figs 10-11. *Laurencia glandulifera* (Kützing) Kützing (Calafuria, June 1995, low littoral). Fig. 10. A tetrasporangial axis. Scale: bar = 1 mm. Fig. 11. Detail of a tetrasporangial branchlet showing the parallel arrangement of tetrasporangia. Scale: bar = 175 μm.

plants and are borne laterally near the tips of ultimate branchlets, singly or in clusters (Fig. 12). Mature cystocarps are sessile, urceolate, 500-700 μm in diameter and contain clavate carpospores 100-150 μm long and 30-50 μm broad (Fig. 13). Spermatangial thalli have not been observed.

Outside the Mediterranean *L. glandulifera* has been reported for several regions (Cecere *et al.*, 1996 and references therein; Silva *et al.*, 1987). In the Mediterranean this species has been collected with certainty only twice since its description (Kützing, 1849): at Rovinj, Adriatic Sea (Saito, 1985) and Cheradi Islands, Ionian Sea (Cecere *et al.*, 1996). The occurrence of this species along Tuscan shores extends the known distribution of *L. glandulifera* in the Mediterranean; moreover,

Figs 12-13. *Laurencia glandulifera* (Kützing) Kützing (Calafuria, June 1995, low littoral). Fig. 12. Apex of a female gametophyte bearing cystocarps. Note the parasite *Erythrocystis montagnei* in the apical pits (arrowhead). Scale: bar = 330 µm. Fig. 13. Detail of a cystocarp. Scale: bar = 370 µm.

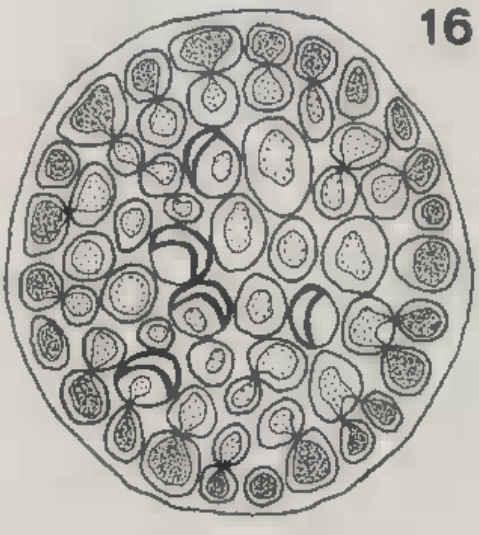
because previous reports referred only to tetrasporangial thalli, cystocarpic plants are recorded for this species for the first time. We agree with Cecere *et al.* (1996) that *L. glandulifera* could be more widely distributed in the Mediterranean since it has been generally regarded as a synonym of *L. paniculata* (C. Agardh) J. Agardh (Hauck, 1885; Preda, 1909), from which, however, it differs in the occurrence of secondary pit-connections, the absence of outer cortical cells which are palisade-like in transverse section and the parallel arrangement of tetrasporangia. Therefore, several Mediterranean records of *L. paniculata* may refer to specimens of *L. glandulifera* and further studies are needed to obtain a more detailed knowledge of the geographical distribution and the ecology of the latter species in the Mediterranean Sea.

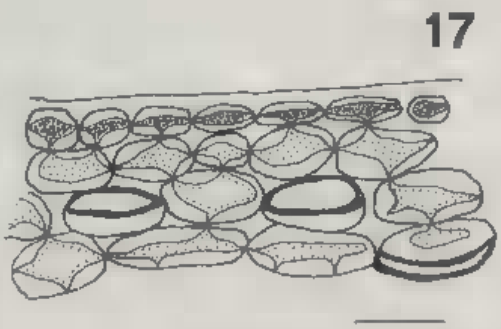
***Laurencia minuta* Vandermeulen, Garbary *et* Guiry subsp. *scammaccae* Furnari *et* Cormaci**

Leaves of *P. oceanica* epiphytized by *L. minuta* subsp. *scammaccae* were collected in June 1994, at depths ranging from 10 m to 24 m, along the southern shores of Elba Island. Thalli of *L. minuta* subsp. *scammaccae* consist of 1-2 erect axes, up to 5 mm tall, arising from a discoid holdfast. Erect axes are club-shaped and widest just below the apices, becoming narrower at their base; they are poorly ramified, usually showing a few short branches near the apices (Fig. 14). Outer cortical cells are polygonal and commonly show secondary pit connections (Fig. 15); in transverse section they appear more or less isodiametric (Fig. 16). Often, in apical parts, outer cortical cells have projecting cell walls; this feature is more evident in fertile specimens. Lenticular thickenings occur abundantly in cell walls of inner cortical cells and medullary cells (Fig. 17). Some female gametophytes bearing cystocarps were observed; cystocarps are ovoid, 400-600 µm in diameter, generally borne near the apices. Mature carpospores are clavate or ovoid, up to 150 µm long and 50 µm broad (Fig. 18).

L. minuta was described by Vandermeulen *et al.* (1990) from specimens epiphytic on the seagrass *Halophila stipulacea* Ascherson in the Gulf of Aqaba (Red Sea). The subspecies *scammaccae*, which seems to differ only in the occurrence of lenticular thickenings in the medullary cells, was described by Furnari & Cormaci (1990) for plants from Capo Passero (South-eastern Sicily), and later recorded in other localities of Sicily (Serio & Pizzuto, 1992; Alongi *et al.*, 1993; Scammacca *et al.*, 1993), in the Ionian Sea (Cecere *et al.*, 1996) and Spain (Boisset & Aranda, 1992). Tuscan thalli appear very similar to those of the type locality and live on the same substrate (leaves of *P. oceanica*).

ACKNOWLEDGEMENTS — We wish to thank Prof. Giovanni Furnari, Prof. Mario Cormaci and Dr Donatella Serio for helpful discussions about *L. glandulifera* and for critical reading of the manuscript. A grateful acknowledgement is also due to Prof. Ileana Puccinelli and to Simone Gabrielli for technical assistance in taking photographs. Anna De Biasi is acknowledged for collection of *A. algeriense*; we are also grateful to Dr Laura Airoldi and Dr Luigi Piazzi for collection of phytobenthos samples and plants of *P. oceanica* in which respectively *A. piliferum* and *L. minuta* subsp. *scammaccae* were found.





Figs 14-18. *Laurencia minuta* Vandermeulen, Garbary *et* Guiry subsp. *scammaceae* Cormaci *et* Furnari (Punta del Nasuto, Elba Island, 12 June 1994, -21 m). Fig. 14. Habit of some thalli. Scale: bar = 1 mm. Fig. 15. Surface view of the outer cortex. Scale: bar = 40 µm. Fig. 16. Transverse section of a plant (basal part of the thallus). Scale: bar = 50 µm. Fig. 17. Longitudinal section, showing lenticular thickenings. Scale: bar = 100 µm. Fig. 18. Schematic detail of ■ cystocarp. Scale: bar = 65 µm.

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